**Children are not small adults**

**Anatomical and Physiological differences between adults and paediatrics**

Neonates, babies and children have some differences that can affect both your assessment and treatment. One of which is that they can go off much more quickly than adults, however it does also mean that they can recover just as quickly!

**Nose breathers**

Babies are obligatory nose breathers and therefore anything that occludes the nasal passages is likely to impede their respiration. For example, secretions, NG tubes, suction catheters.

N.B. Because babies are surviving with increased prematurity, the reliance of nasal breathing is higher still.

**Airway Diameter**

The adult trachea measures 14-15mm in diameter compared to a young babies which only measures 5mm in diameter.

Because the airway is much narrower there is increased airway resistance. Resistance can be increased further by any blockages in the trachea, for example, mucous plug, oedema (resulting from infection, intubation, suction and conditions such as bronchiolitis). With increased airway resistance there is increased risk if atelectasis.

**Bronchial Wall Structure**

More cartilage and soft tissue  
Larger amount of mucous glands  
Premature cilia  
Fewer smooth muscle cells  
Fewer and more immature alveoli

The combination of the above, results in a higher incidence of occlusion, airway collapse and difficulty clearing secretions.

**Air/Tissue Surface Area ratio**

Fewer and more immature alveoli  
Smaller airways  
Reduced area for gas exchange  
High risk for atelectasis which can increase respiratory distress
Rib Position

The ribs are more cartilaginous in the infant and subsequently the chest wall is more compliant. The position of the ribs is also more horizontal and therefore there is no ‘bucket handle’ action during respiration up to the age of 2 years. Without this movement the infant is completely reliant on its diaphragm for inspiratory and expiratory phase.

Diaphragm

The horizontal attachment of the ribs results in a flat diaphragm. This causes the diaphragm to be working at a mechanical disadvantage and the only way the infant is able to increase its minute volume is by increasing its respiratory rate.

The diaphragm in an infant has fewer fatigue resistant fibres (30% compared to 50-60% in an adult) thus causing: - Reduced respiratory reserve - Higher respiratory rate at rest (40-60 br/min)

Abdominal distension can compromise the infant.
An increase in respiratory rate is the first sign of respiratory distress.

Contents of the Thoracic Cavity

In an infant, the heart is comparatively large (approx ½ diameter on X-ray compared to 1/3 diameter in adults).

The thymus is present and any thoracic mass will compound to reduce the room for lung expansion.

Chest Wall Compliance

This is very high in children and is close to that of the lung. Because of this the closing volume is within the tidal volume. The FRC is also low.

This results in: An increase in work of breathing A slightly lower pO₂ in the 1st year of life Marked recession in the rib cage during respiratory distress Predisposition to atelectasis

Ventilation/Perfusion ratio

Ventilation is opposite to adults
They do not have rigid rib cages so in side lying as the ribs are squashed so the underlying lung is compromised, therefore the upper lung receives better ventilation whilst the squashed lung has preferential perfusion.
Collateral Ventilation

This is thought to be present but underused in the neonate. Therefore there is an increased risk of terminal airway collapse.

Basal Metabolic Rate

The oxygen consumption of a newborn is twice that of an adult. Therefore there is a higher oxygen requirement during times of stress and a more rapid development of hypoxia leading to bradycardia.

Cardiac Muscle

There is a higher percentage of connective tissue to muscle. Therefore, as they are unable to increase their stroke volume, the infant must increase its heart rate in order to increase their cardiac output.

Skin Surface to Body Mass ratio

Infants are very sensitive to heat loss due to a high skin surface to body mass ratio. This means that they can cool down very quickly. Particular care should be taken when treating neonates. It is also worth bearing in mind that they are unable to shiver!

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<table>
<thead>
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<tbody>
<tr>
<td>Adult</td>
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<tr>
<td>Term infant</td>
<td>0.07m/kg</td>
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<tr>
<td>Preterm</td>
<td>&lt;6 times the adult ratio</td>
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Sleep

There is an increased REM sleep in infants, and this increases further in premature babies. During REM there is:

- Reduction in FRC
- Inhibition of intercostals and other smooth muscle
- Loss of tone in the laryngeal muscles that leads to
- Loss of auto PEEP.

Therefore during REM the infant is breathing closer to its closing volumes and therefore is more likely to have apnoeas.

Bibliography


Written with assistance from Christina Anderson, Senior Physiotherapist, BCH.